

[illegible]

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```

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LLLLLLLLLLLLLL IIIIIIII               SSSSSSSS
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```



```
0000 1      .title pli$div_pkshort
0000 2      .ident /1-002/
0000 3      ; Edit WHM1002
0000 4      ;*****
0000 5      ;
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0000 23     ;
0000 24     ;*****
0000 25     ;*****
0000 26     ;
0000 27     ;++
0000 28     ;
0000 29     ;
0000 30     ; routine:
0000 31     ;
0000 32     ;     PLISDIV_PKSHORT
0000 33     ;
0000 34     ;
0000 35     ; facility:
0000 36     ;
0000 37     ;     VAX/VMS PL1 runtime library.
0000 38     ;
0000 39     ; abstract:
0000 40     ;
0000 41     ;     Runtime routine performs fixed decimal (packed decimal) division.
0000 42     ;     The routine is called when precision and scale requirements for
0000 43     ;     the quotient imply multiple precision division. The routine is
0000 44     ;     only called when such multiple precision division is required and
0000 45     ;     when the divisor has a precision of less than 30 decimal digits.
0000 46     ;     (Call pli$div_pk_long if multiple precision division is
0000 47     ;     required and the divisor has precision 30 or 31 decimal digits).
0000 48     ;
0000 49     ; author: Peter Baum 20-jun-1980
0000 50     ;
0000 51     ; modifications:
0000 52     ;
0000 53     ;
0000 54     ;
0000 55     ;     1-002 Bill Matthews 29-September-1982
0000 56     ;
0000 57     ;     Invoke macros $defdat and rtshare instead of $defopr and share.
```



```
0000 58 :
0000 59 :
0000 60 :
0000 61 :
0000 62 : documentation file: [pl1.doc.codegen]THEORY.MEM
0000 63 :
0000 64 : functional description:
0000 65 :
0000 66 :     This routine calculates:
0000 67 :
0000 68 :     z = x / y
0000 69 :
0000 70 :     let a = scale(z) + scale(y) - scale(x) - 31 + prec(x)
0000 71 :         b = scale(z) + scale(y) - scale(x) + prec(x)
0000 72 :         c = 31 - prec(x)
0000 73 :         d = 31 - prec(y)
0000 74 :
0000 75 :     this routine is called if b > 31 and d > 1
0000 76 :
0000 77 :     Prior to the call:
0000 78 :         if c not 0 then shift x left by c.
0000 79 :         Thus x is a 31 digit packed decimal.
0000 80 :
0000 81 :
0000 82 :
0000 83 :
0000 84 :     input:
0000 85 :         0(ap)  # of arguments
0000 86 :         4(ap)  address of dividend (shifted left by c)
0000 87 :         8(ap)  address of divisor
0000 88 :         12(ap) precision of divisor (high order bytes zeroed)
0000 89 :         16(ap) address of quotient
0000 90 :         20(ap) precision of quotient (high order bytes zeroed)
0000 91 :         24(ap) a as defined above (high order bytes zeroed)
0000 92 :         28(ap) d as defined above (high order bytes zeroed)
0000 93 :
0000 94 :
0000 95 :     output:
0000 96 :         quotient returned at address specified by 16(ap)
0000 97 :
0000 98 :
0000 99 :     variable usage:
0000 100 :
0000 101 :
0000 102 :
0000 103 :
0000 104 :
0000 105 :
0000 106 :
0000 107 :
0000 108 :
0000 109 :
0000 110 :
0000 111 :
0000 112 :
0000 113 :
0000 114 :
```

variable	size in digits	use
x(ap)	31	Dividend
y(ap)	py(ap)	Divisor
py(ap)	-----	Binary number that gives precision of y
z(ap)	pz(ap)	Quotient
pz(ap)	-----	Binary number that gives precision of z
(sp)	31	Initially abs(x); successive remainders as algorithm progresses.
stkz2(sp)	d	Temporarily holds the next d digits of quotient.
stkt1(sp)	31	Temporary because packed instructions


```
0000 115 :
0000 116 :
0000 117 :
0000 118 :
0000 119 :
0000 120 :
0000 121 :
0000 122 :
0000 123 :
0000 124 :
0000 125 :
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0000 162 :
0000 163 :
0000 164 :
0000 165 :
0000 166 :
0000 167 :
0000 168 :
0000 169 :
0000 170 :
0000 171 :
```

stkyl(sp) 31
stkylsign(sp)

don't allow overlapped operands
Holds abs(y)
2 bits used to indicate the sign of the
quotient. 00=+, 10=+, 01=-; via incb

register usage:

register	use
r6	a = additional digits of precision required beyond prec(x)
r7	stkyl(sp) = address of divisor
r8	py(ap) = precision of divisor
r9	r = number of additional digits of the quotient that are to be found for next step
r10	z(ap)
r11	d = 31 - prec(y) = max. no of digits obtained each iteration

optimization notes:

- 1) Optimized for speed, not space.
- 2) Optimized for y > 0.
- 3) Assumes speed for register to register operations are the same
for byte operations and longword operations.
- 4) Many packed instruction sequences were timed. Do not change
unless actual tests are made to determine relative speed.
Tests were made on 11/780 and Comet.

--

stack offsets for work area

\$offset 0,,<-	:
<,16>,-	:abs(x), 31 digits
<stkz2,16>,-	:z2 31 digits
<stkt1,16>,-	:t1 31 digits
<stkyl,16>,-	:abs(y)
<stkylsign,1>,-	:sign of quotient, 2 bits
<stklenn,0>,-	:length of work area
>	:

parameter offsets

\$offset 4,,<-	:
<x>,-	:x = dividend by reference
<y>,-	:y = divisor by reference
<py>,-	:prec(y) by value
<z>,-	:z = quotient by reference
<pz>,-	:prec(z) by value
<consta>,-	:a by value
<constd>,-	:d by value
>	:


```
0000 172 :
0000 173 :
0000 174 :      rtshare
0000 175 :
0000 176 :      constant data area
0000 177 :
0C 0000 178 zero:  .packed +0      ;local packed decimal constant zero
0001 179 :
0001 180 :      local symbol definitions
0001 181 :
0000000F 0001 182 bytes_to_sign=15      ;bytes to sign for fixed decimal 31
0001 183 :
0001 184 :
0001 185 :
0001 186 :
CFFC 0001 187      .entry  pli$div_pkshort,^M<iv,dv,r2,r3,r4,r5,r6,r7,r8,r9,r10,r11>
0003 188 :
0003 189 ;initialize registers and temporaries
0003 190 :
5E BF AE 9E 0003 191      movab  -stklen(sp),sp      ;make room for temporaries
5A 10 AC D0 0007 192      movl    z(ap),r10      ;save address of quotient
57 30 AE 9E 000B 193      movab  stky(sp),r7      ;address of divisor
58 0C AC D0 000F 194      movl    py(ap),r8      ;precision of divisor
5B 1C AC D0 0013 195      movl    constd(ap),r11     ;d = 31 - prec(y)
56 18 AC D0 0017 196      movl    consta(ap),r6     ;a = scale(z) + scale(y) - scale(x)
001B 197      ; - 31 + prec(x)
6E 04 BC 40 AE 94 001B 198      clrb    stksign(sp)      ;clear sign flag
1F 34 001E 199      movp    #31,@x(ap),(sp)      ;move x, set cond. code
26 14 0023 200      bgtr    50$      ;branch if x>0
1E 19 0025 201      blss    40$      ;branch if x<0
0027 202 :
0027 203 ;x = 0
0027 204 :
08 BC 58 D5 AF 00 37 0027 205      cmpp4  #0,zero,r8,@y(ap)      ;set condition code
14 AC 00 CB AF 00 0A 13 002E 206      beql    30$      ;branch if divide by 0
00 6A 0030 207      ashp    #0,#0,zero,#0,pz(ap),(r10) ;z = 0
0038 208 :
BF AF 00 C2 AF 00 27 0039 208      ret
6A 14 AC 0041 209 30$:  divp    #0,zero,#0,zero,pz(ap),(r10) ;cause divide by 0
0044 210      ret
0045 211 :
0045 212 ;x not 0, determine sign of x
0045 213 :
0045 214 40$:
40 AE 96 0045 215      incb    stksign(sp)      ;set low order bit
0F AE 97 0048 216      decb    bytes_to_sign(sp)      ;x < 0 so make it positive
004B 217 :
004B 218 ;determine sign of y
004B 219 ;y may be 0 at this point
004B 220 ;code optimized for y>0
004B 221 :
004B 222 50$:
67 08 BC 58 34 004B 223      movp    r8,@y(ap),(r7)      ;move y into temporary
0C 18 0050 224      bgeq    60$      ;branch if y >= 0
58 A4 AF 00 08 BC 58 23 0052 225      incb    stksign(sp)      ;set neg indicator
0055 226      subp6    r8,@y(ap),#0,zero,r8,(r7) ;convert to positive
```



```

67      005D
        005E 227 60$:
        005E 228 :
        005E 229 :start of divide proper; setup
        005E 230 :
        67 58 6E 1F 37 005E 231      cmp4  #31,(sp),r8,(r7)      ;x<y?
        13 19 0063 232      blss  95$      ;branch if x<y, i.e. shift of d is o.k.
        0065 233 :
        0065 234 :y < x
        0065 235 :
6A 14 AC 6E 1F 67 58 27 0065 236      divp  r8,(r7),#31,(sp),pz(ap),(r10) ;z=x/y
1F 6A 14 AC 67 58 25 006D 237      mulp  r8,(r7),pz(ap),(r10),#31,stk1(sp) ;t1=(x/y)*y
        20 AE 14 11 0074 238      brb    110$      ;
        0078 239 :
        0078 240 :x < y
        0078 241 :
14 AC 00 83 AF 00 00 F8 0078 242 95$:      ashp  #0,#0,zero,#0,pz(ap),(r10) ;clear quotient
        6A 11 11 0081 243      brb    115$      ;
        0083 244 :
        0083 245 :start of multiple precision divide
        0083 246 :
        1F 10 AE 5B 67 58 25 0083 247 100$:      mulp  r8,(r7),R11,stk2(sp),#31,stk1(sp) ;t1=y*z2
        6E 1F 20 AE 20 AE 1F 22 008A 248 110$:      subp4  #31,stk1(sp),#31,(sp) ;x=x-t1
        41 13 0092 249      beql  150$      ;branch if remainder = 0
        0094 250 :
        0094 251 :determine r, the number of the next low order digits to obtain
        0094 252 :
        59 5B D0 0094 253 115$:      movl  r11,r9      ;r=d
        5B 56 D1 0097 254      cmpl  r6,r11      ;a>d?
        03 14 009A 255      bgtr  130$      ;branch if larger
        59 56 D0 009C 256      movl  r6,r9      ;r=a
        20 AE 1F 00 6E 1F 59 F8 009F 257 130$:      ashp  r9,#31,(sp),#0,#31,stk1(sp) ;shift x left by r
        14 AC 00 6A 14 AC 59 F8 00A7 258      movp  #31,stk1(sp),(sp) ;copy back into x
        20 AE 14 AC 20 AE 14 AC 34 00AC 259      ashp  r9,pz(ap),(r10),#0,pz(ap),stk1(sp) ;shift z left by r
        10 AE 5B 6A 20 AE 14 AC 34 00B6 260      movp  pz(ap),stk1(sp),(r10) ;copy back into z
        6A 14 AC 10 AE 5B 27 00BC 261      divp  r8,(r7),#31,(sp),r11,stk2(sp) ;z2(d)=x/y
        56 59 C2 00C4 262      addp4  r11,stk2(sp),pz(ap),(r10) ;z=z+z2
        16 40 AE E8 00CE 263      subl2  r9,r6      ;a=a-r
        04 00D0 264      bneq  100$      ;branch if more
        00D4 265      blbs  stksign(sp),155$      ;branch if quotient < 0
        00D5 266      ret
        00D5 267 :
        00D5 268 :remainder = 0
        00D5 269 :
        14 AC 00 6A 14 AC 56 F8 00D5 270 150$:      ;remainder = 0
        00DD 271      ashp  r6,pz(ap),(r10),#0,pz(ap),stk1(sp) ;account for scale
        00DF 272      blbs  stksign(sp),160$      ;branch if quotient < 0
        6A 20 AE 0D 40 AE E8 00E3 273      movp  pz(ap),stk1(sp),(r10) ;copy back into quotient
        04 00E9 274      ret
        00EA 275 :
        00EA 276 :quotient < 0
        00EA 277 :
```

PL\$DIV_PKSHORT
1-002

F 10

16-SEP-1984 02:22:40 VAX/VMS Macro V04-00
6-SEP-1984 11:39:10 [PLIRTL.SRC/PLIPKDIVS.MAR;1

Page 6
(1)

	20	AE	6A	14	AC	34	00EA	278	155\$:	movp	pz(ap),(r10),stkt1(sp)	;copy quotient into temp
							00F0	279	160\$:			;enter if t1 holds quotient
FF07	CF	00	20	AE	14	AC	23	00F0	280	subp6	pz(ap),stkt1(sp),#0,zero	pz(ap),(r10);make z negative
			6A	14	AC		00F9					
						04	00FC	281		ret		
							00FD	282				
							00FD	283		.end		

PLISDIV_PKSHORT
Symbol Table

G 10

16-SEP-1984 02:22:40 VAX/VMS Macro V04-00 Page 7
6-SEP-1984 11:39:10 [PLIRTL.SRC]PLIPKDIVS.MAR;1 (1)

BYTES_TO_SIGN = 0000000F
CONSTA 00000018
CONSTD 0000001C
DIR = 00000001
PLISDIV_PKSHORT 00000001 RG 02
PY 0000000C
PZ 00000014
STKLEN 00000041
STKSIGN 00000040
STKT1 00000020
STKY 00000030
STKZ2 00000010
X 00000004
Y 00000008
Z 00000010
ZERO 00000000 R 02

! Psect synopsis !

PSECT name	Allocation	PSECT No.	Attributes
ABS	00000000 (0.)	00 (0.)	NOPIC USR CON ABS LCL NOSHR NOEXE NORD NOWRT NOVEC BYTE
\$ABSS	00000041 (65.)	01 (1.)	NOPIC USR CON ABS LCL NOSHR EXE RD WRT NOVEC BYTE
_PLISCODE	000000FD (253.)	02 (2.)	PIC USR CON REL LCL SHR EXE RD NOWRT NOVEC LONG

! Performance indicators !

Phase	Page faults	CPU Time	Elapsed Time
Initialization	9	00:00:00.07	00:00:00.32
Command processing	77	00:00:00.51	00:00:01.69
Pass 1	67	00:00:01.18	00:00:02.27
Symbol table sort	0	00:00:00.01	00:00:00.01
Pass 2	51	00:00:00.63	00:00:01.16
Symbol table output	2	00:00:00.02	00:00:00.02
Psect synopsis output	1	00:00:00.02	00:00:00.02
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	207	00:00:02.45	00:00:05.49

The working set limit was 750 pages.
6483 bytes (13 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 16 non-local and 12 local symbols.
283 source lines were read in Pass 1, producing 12 object records in Pass 2.
3 pages of virtual memory were used to define 3 macros.

```

+-----+
! Macro library statistics !
+-----+

```

Macro library name

Macros defined

_\$255\$DUA28:[PLIRTL.OBJ]PLIRTMAC.MLB;1

3

-\$255\$DUA28:[SYSLIB]STARLET.MLB;2

5

TOTALS (all libraries)

END

44 GETS were required to define 3 macros.

There were no errors, warnings or information messages.

MACRO/ENABLE=SUPPRESSION/DISABLE=TRACEBACK/LIS=LIS\$:PLIPKDIVS/OBJ=OBJ\$:PLIPKDIVS MSRC\$:PLIPKDIVS/UPDATE=(ENH\$:PLIPKDIVS)+LIB\$:PLIRTM

[illegible]

0308 AH-BT13A-SE
VAX/VMS V4.0

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